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United States Department of Agriculture,
BUREAU OF ENTOMOLOGY,
L. O. HOWARD, Entomologist and Chief of Bureau.

THE MOST IMPORTANT STEP IN THE CONTROL OF THE BOLL WEEVIL.

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Damage by the boll weevil during the present season (1908) has one very peculiar feature. Except in the southern third of the total infested area the damage by this insect has been considerably less than normal. This situation was caused principally by very exceptional climatic conditions in the fall of 1907 which reduced greatly the numbers of weevils that passed through the winter. As these peculiar conditions did not extend to the southern limits of the weevil-infested area, the crop has been cut very short in southern localities both in Texas and Louisiana. With normal conditions during the coming fall and winter the weevil problem will be as serious everywhere next year as it has been in the southern regions during the present season. This circular points out exactly how planters can avert such a catastrophe. Now is the time to prepare for the crop of next season.

It has been repeatedly pointed out in publications of the Department of Agriculture that the most important step in controlling the boll weevil is the removal of the plants from the field as early as practicable in the fall. This was one of the original suggestions made by the Chief of this Bureau when the boll weevil was confined to a comparatively small area in Texas. Much subsequent work has shown the value of the original recommendation. Unfortunately the process of fall destruction of plants for controlling the boll weevil has been taken up but slowly by the planters. This is largely on account of the practical difficulties relating to the tenant system, and the scarcity of labor which has interfered with picking out the crop.

The agitation of the necessity for procuring an early crop in order to avoid damage by the cotton boll weevil has been carried on to such an extent by the Department of Agriculture that the details have become common knowledge. There is, however, a tendency on the part of many planters to lose sight of the fact that procuring an early crop is but one step, and is strictly secondary to the great essential step, namely, the destruction in the fall of the plants in the field. As a matter of fact, early planting, the use of early varieties, and the use of fertilizers are simply to further the advantage gained by the process of fall destruction.

A PRACTICAL ILLUSTRATION.

In the fall of 1906 the Bureau of Entomology conducted a large practical field test of the effectiveness of fall destruction of the plants in the control of the weevil. An isolated locality was found in Texas where over 400 acres of cotton were grown. There was no other cotton grown

in any direction nearer than 15 miles. Through an agent of the Bureau, Mr. J. D. Mitchell, to whom great credit is due for the direct management of the matter, arrangements were made by contract with the farmers concerned, under which all the cotton plants were uprooted and burned during the first ten days in October. Provision was also made to prevent the growing of volunteer or sprout cotton. In this way an opportunity was obtained for an ideal experiment to show what can be accomplished by the procedure that is now recommended by the Department. About 15 miles from the locality in which the experiment was performed a considerable quantity (295 acres) of cotton was grown. In this region the stalks were not destroyed in the fall, and observations made here have been used as a check upon the experimental area. The class of farmers is about the same in the two localities. The experiment was performed at Olivia, in Calhoun County, Tex., and the cotton utilized as a check was located at Six Mile, a settlement across Lavaca Bay, in the same county.

Mr. Mitchell visited the Olivia and Six Mile localities early in May, 1907. At that time, in the former area, extensive search revealed but a single weevil. In the Six Mile locality, however, the weevils were so numerous that practically all the squares had become infested. Other examinations were made, all of which showed the same advantage in regard to freedom from the weevil of the area in which the stalks were destroyed. On August 20 Mr. Mitchell found an average of over 10 bolls per plant at Olivia and only 3 bolls per plant in the check area.

The conspicuous results of the experiment, however, are revealed by the increased yield shown after the cotton was picked. The average in all fields at Olivia was 0.41 bale as against 0.15 at Six Mile. This increase of slightly over a quarter of a bale per acre (to be exact, 0.26 bale) was due to the destruction of the stalks. In order to determine the exact financial advantage to the farmers at the Olivia locality, a calculation has been made on the basis of the separate sale of lint and seed. At Olivia the crop following the destruction of the plants averaged 615 pounds of seed cotton per acre, that is, 205 pounds of lint and 410 pounds of seed. At the Six Mile settlement the average yield of seed cotton per acre was 225 pounds, that is, 75 pounds of lint and 150 pounds of seed. It is evident that the work done in the destruction of the plants at Olivia resulted in the gain of 130 pounds of lint and 260 pounds of cotton seed per acre. On the basis of a value of 10 cents per pound for the lint and of $12 per ton for the seed, the increase amounted to $14.56 per acre. This is about 29 times the cost of uprooting and burning the plants the preceding fall, as shown by the actual amount the Department paid for the work.

The full importance of the results just mentioned can not be realized until it is understood that the soil at Olivia is much less fertile than that at Six Mile. Mr. Mitchell, who is thoroughly familiar with the productiveness of lands in that part of the State, estimated that the Six Mile land is at least a third more fertile than that at Olivia. This estimate was more than borne out by the amount of seed produced at the two places during the season of 1907. At Six Mile the average height of the plants, determined by measuring, was 4 feet, while at Olivia the average was 2.2 feet. The estimate recorded of the advantage resulting from the work at Olivia is made without reference to this difference in fertility.

The practical experiment, as has been stated, returned substantially 29 times the cost of the necessary outlay. Under other conditions this advantage would necessarily be smaller. The experiment was carried on purposely to show the great advantage of fall destruction where there are no other factors to interfere with the results. Where cotton is less isolated than that at Olivia there will be less effective results, of course, on account of the influx of weevils from fields that may not have been properly treated. Nevertheless, such conditions could not possibly obliterate all effectiveness. In fact, only the most extreme and exceptional conditions could possibly result in reducing the advantage obtained in the experiment by more than 50 per cent. That means that any cotton planter, by the process of fall destruction, can insure himself an increased yield to the value of from $5 to $10 per acre by a small amount of work at the proper time in the fall.

REASONS FOR THE DESTRUCTION OF THE PLANTS IN THE FALL.

There are four principal reasons why the process of fall destruction recommended in this circular should be practiced universally by planters in infested regions:

First.—Fall destruction prevents absolutely the development of a multitude of weevils which would otherwise become adult within a few weeks of the time of hibernation. The destruction of the immature stages of weevils in infested squares and bolls is accomplished, while the further growth of squares, which may become infested later, is also prevented. This stops materially the development of weevils which would normally hibernate successfully, and by thus decreasing the number of weevils which will emerge in the spring the chances for a successful crop the following season are very greatly increased.

Second.—A proper manipulation of the stalks will bring about the destruction of a great majority of the weevils which are already adult. This will be accomplished partly by causing the starvation of many weevils before the natural time for hibernation, and partly by exposure to severe cold during the fall and winter.

Third.—It has been shown conclusively that the bulk of the weevils which survive the winter are those which reach maturity late in the season. It is evident that the weevils that pass the winter and attack the crop of the following season are among those developed latest in the fall and which, in consequence of that fact, have not exhausted their vitality by depositing eggs for any considerable length of time. Fall destruction of the plants, increasing the length of the hibernating period, reduces many fold the number of weevils in the fields that would otherwise emerge in the spring to damage the cotton.

Fourth.—Clearing of the field in the fall makes it possible to practice fall plowing, which is not only the proper procedure in any system of cotton raising, but also greatly facilitates the early planting of the crop the following spring. The ground becomes clean by this practice, so that but few places for shelter are left to the weevils, and various climatic conditions still further reduce the number of the survivors.

DATA UPON WHICH THE FOREGOING REASONS ARE BASED.

The reasons for fall destruction given above are based upon a very large amount of data from actual experiments and the work of various planters. The information at hand was greatly amplified in a series of

large-scale experiments carried on during the winter of 1906–7. Three large cages (50 by 20 feet) were built over growing cotton at Dallas, Calvert, and Victoria, in Texas. In different compartments of these cages nearly 70,000 weevils were placed; several thousand in each compartment. After the weevils were placed inside, the plants were removed from the first section about the middle of October. At regular subsequent dates other sections were treated in exactly the same manner. Consequently the results for each locality show exactly what a farmer could have accomplished by the destruction of the plants at different times. The full results will be published in Bulletin 77, of this Bureau, by Dr. W. E. Hinds and Mr. W. W. Yothers, who have had direct charge of the work. In this connection it is necessary to call attention to only a few features.

In practically all cases the smallest survival of weevils was found in those cages from which the plants were removed at the earliest dates, and the number of survivors increased regularly as the dates of destruction became later. For instance, at Dallas out of between two thousand and three thousand weevils in each cage, only 2.5 per cent survived when the plants were removed on October 13; 4 per cent survived destruction of the food supply on October 16; 6.2 per cent survived destruction on October 19; 12.2 per cent survived destruction on November 6, and 14.7 per cent survived destruction on November 12. *These figures indicate that practically seven times as many weevils survived after destruction of plants on November 12 as survived after a similar destruction on October 13. This is a most striking illustration of the effect of early destruction.*

In the cages at Dallas, Calvert, and Victoria, from which the plants were removed in November, 14.26 per cent survived, while 4.41 per cent survived removal of the plants in October—that is, the cutting off of the food supply in November resulted in the survival of three times as many weevils as survived when the work was done in October. These figures are based upon averages of eight large cages at the three localities in which October destruction took place, as compared with seven similar cages in which the plants were removed in November.

TIME FOR DESTRUCTION OF THE PLANTS.

It is naturally impossible to fix any date for the destruction of the stalks which would apply to all localities and under all conditions. The condition of the soil must be considered as well as the maturity of the crop. While the condition of the soil can not be controlled, the time of the maturity of the crop, except in extremely unfavorable seasons, is largely within the power of the planter, since by early planting of early maturing varieties the entire crop may be matured before the usual time of picking of the first cotton from native seed. Nevertheless, whatever modifications are necessary in different localities and during different seasons, they do not decrease the general strength of the recommendations.

The proper time for the destruction of the plants in the fall is whenever the weevils have become so numerous that there is no prospect that any more cotton will be made. It will be an easy matter for any planter to determine this point by an examination of a few plants in his field. Whenever it is found that all, or nearly all, of the squares and some of the bolls are being punctured, there is no hope for pro-

ducing any more cotton. The farmer should then wait until the bolls already set on the plants have opened, and destruction should then take place immediately.

The rule should consequently be that the plants should be destroyed in the fall whenever all or practically all of the fruit is being damaged, regardless of whether this is in September or November. In the great majority of cases in Texas and in Louisiana the month of October would be the proper time. In many cases earlier destruction could and should be practiced. Nevertheless, it should not be thought that fall destruction will be useless after the time mentioned. Even until much later many weevils in the remains of bolls hanging to the plants may be destroyed, but the process loses in value the longer it is deferred. By all means, if possible, the destruction of plants should take place before frost, but destruction after frost, though not nearly as efficacious as earlier destruction, should always be practiced when it has not been possible to remove the plants previously.

METHOD OF REMOVING THE PLANTS.

The common practice of removing the cotton stalks from the fields by the use of the stalk cutter (a wheeled cylinder provided with knives) is not effective in the fall destruction that should be practiced to avoid damage by the boll weevils. The stalks remaining in that case during mild weather give rise to sprouts, which furnish an abundance of food to weevils that would otherwise starve. Moreover, the fact that this machine cuts the stalks into short pieces makes the necessary collection of them difficult.

There are two effective methods of removing the plants from the ground. One of these, the method to be preferred, is to cut the roots 2 or 3 inches beneath the surface by the use of an ordinary plow. The other is to pull out the stalks by the use of a lever provided with a toothed notch which grasps the base of the plant. The latter process is better adapted for use when the plants have been killed by frost. When they are still green, or the ground is dry, it is frequently a difficult matter to remove them with these levers. The Department's general recommendation, therefore, is that the plants should be plowed out. As soon as possible after this is done they should be collected by hand or by means of rakes and brought together in large heaps or windrows. It is very important that this collection should take place before the leaves have become dry and have dropped off. When the plants are carried to heaps immediately after uprooting, all of the leafage, which will dry in a few days, remains to facilitate the burning of the stalks.

After the stalks have become dry enough they should be burned. If the weather be fair, this can be done in about two weeks. If rains cause a lengthening of this period, it would undoubtedly be worth the cost to the planter to purchase crude oil sufficient to bring about the complete burning of all the stalks.

It is not considered necessary to leave any trap rows to attract such weevils as may have escaped the burning. The weevil seems to have but little tendency to be attracted to such plants. After the destruction of the main crop the spread would probably be in all directions and the numbers collected on the trap rows would consequently be inconsiderable. The time and expense of properly carrying on the

hand picking of the weevils and infested fruit on trap rows would be a considerable handicap to the method on many plantations. Nevertheless, on small places where suitable labor is abundant, traps could conveniently be left. In such cases they should be situated on those sides of the fields which are generally leeward. They should be examined daily for weevils and infested squares and bolls, which should be immersed in crude oil. After such collection for ten days, the trap plants should be uprooted and burned immediately with the aid of crude oil.

The suggestion has been made at various times that grazing the cotton fields with cattle is in some cases equivalent to destruction in the way that has been suggested. However, in many parts of the infested area there are not sufficient cattle to accomplish the work, and, moreover, in very many fields the cattle, by disseminating Johnson grass and other plant pests, would undoubtedly do more harm than good. At the same time the most thorough grazing always leaves a few green sprouts or leaves upon which weevils may feed, and of course leaves the stalks standing, so that the process of leafing, for the benefit of the weevils, may continue indefinitely. Where the condition of the fields permits and the supply of cattle is sufficient, grazing the fields should be practiced, but this can not generally be the case in the infested area.

DIFFICULTIES.

The Department of Agriculture understands that there are some difficulties in the way of a universal following of the recommendations given in this circular. The principal ones are the almost universal hope for a top crop and in the labor conditions consequent from the more or less universal tenant system of producing the staple. These difficulties are increased by the general scarcity of labor in the South, which is becoming more and more a serious problem in raising cotton.

Planters in infested localities must understand that with the presence of the weevil there is no longer any hope of a top crop. It is true that after considerable cotton has matured, and after the plants have applied their energy to the formation of seeds and lint, fall rains often stimulate the production of a great number of squares. Many planters are misled by this into the hope of gathering a large top crop. The joints of the plant are short and the squares are formed rapidly and close together. Though weevils may have been exceedingly numerous in the fields, the presence of this abundance of food causes them to scatter, and they are consequently temporarily somewhat less in evidence. In many cases blooms appear and the hope for a top crop increases. Nevertheless, this production of squares also contributes to the production of a large number of weevils late in the season and just at the time for their successful hibernation. As a result of this fact great injury is done to the crop of the following season, with no gain whatever, or a very small one, in the yield of the current season. From these considerations it seems plain that within the weevil territory all hope of a top crop must be given up and the destruction of the plants be practiced as early in the fall as possible.

Another important difficulty lies in the tenant system. It is usually the practice to terminate the work of the tenant with the picking of the cotton, leaving the clearing of the field for the next cropper. At present, after the cotton is picked the tenants frequently move to other planta-

tions or to other parts of the same plantation. It should not be a difficult matter for planters to induce their tenants to practice the fall destruction of the plants as the last step in the production of a crop. In any case the plants have to be removed before the ground can be prepared for planting the following season; and the present recommendation merely involves applying, at a time some months earlier, the same amount of labor as is necessary in the spring. The best solution of the difficulty arising from the tenant system would be in the inclusion, in the agreement between the landlord and the tenant, of a provision which would bind the latter to clean the land thoroughly before leaving it.

In a comparatively small area in southwestern Texas it might be considered that there would be a further objection in the practice which some farmers have of encouraging the growth of volunteer or seppa cotton in the hope of procuring an early and inexpensive crop. As has been repeatedly pointed out by the Department of Agriculture, this is beyond question the worst possible practice in weevil-infested regions. The disastrous experience of several counties in the southern portion of the State during several seasons has abundantly demonstrated the force of the warnings that have been issued from time to time. The staple produced by volunteer plants is short, kinky, and undesirable. Before the advent of the weevil the only reason for encouraging such growth was to procure the first bale. Now, on account of its very detrimental bearing on the weevil problem, any attempt to raise cotton from volunteer cotton should by all means be discouraged.

The point may be raised that the burning of the plants in the fall removes valuable fertilizing constituents and that the continuance of the practice would seriously reduce the fertility of the soil. In reference to this matter, however, it must be stated that the present general practice is to clear the fields by burning the plants in the spring. Therefore, practically the only additional draft upon the soil by the method recommended is in the burning of many of the leaves and a portion of the roots. However, destruction of the plants can only take place after many of the leaves have fallen, and, in other cases, when the plants have become completely defoliated by the cotton caterpillar. The fertilizing constituents in various parts of the cotton plant have been carefully determined.[1] An estimate of the value of all the constituents which could possibly be removed by fall destruction, based upon the schedule of trade values adopted by experiment stations for 1898, shows that the loss per acre would be very small. It is plain that the planter could not only regain this small loss but actually greatly increase the fertility of the land by the use of commercial fertilizers, which would cost an inconsiderable amount in comparison with the gain in the following crop, as a result of lessened damage by the boll weevil. In some cases, of course, the removal of humus furnished by the stalks may be more important than the removal of the fertilizing elements. It is urged, however, that the cheapest and most effective way to add humus to the soil is by green manuring, which is receiving more and more attention throughout the cotton belt.

As a matter of fact, the preceding objections are not necessarily serious. They deal with general changes in cotton culture made neces-

[1] See Bulletin 33 of the Office of Experiment Stations of this Department, pp. 81 to 142.

sary by the ravages of the boll weevil. As is beginning to be well known to planters, it will not be possible for tenants to work as much land as formerly. More cotton will be produced by decreasing acreages and increasing the attention given to what remains. If this is done the objections mentioned will largely disappear.

CONCLUSION.

Having studied and tested the methods of weevil control which have been hitherto recommended, the writer firmly believes that the destruction of the stalks in the early fall is the most effective method known of actually reducing the numbers of the pest. This destruction will cost but a small fraction of the expense necessary in the frequent picking up in the spring of the squares infested by the hibernated weevils, and is far more thorough as a means of reducing the numbers of the weevil than is the practice of picking hibernated weevils from the young plants. Early destruction of the stalks is essential to the greatest success of any system of controlling the pest. All other practices recommended, though very valuable in securing a crop, are of the greatest value as they are followed in connection with this one prime essential. Since the earliest investigations of the boll weevil made by this Department, it has been recognized and pointed out by Dr. L. O. Howard that this practice is of the first importance, and the experience of recent years has added but certainty to this conviction. A number of planters have adopted it, and their work and the large-scale work by the Bureau of Entomology have abundantly demonstrated its effectiveness. *It must not be thought that the procuring of the immediate crop is the only thing to be desired. Early and complete destruction of the stalks is undoubtedly the most important single element insuring success for the subsequent year.*

Concerted action in fall destruction is, of course, desirable. The greatest benefit will result only when whole communities adopt the method. But no planter should hesitate on account of the indifference of his neighbors. The fact that weevils move about but little until the time when the bulk of the crop is safe will assist materially in saving one field though near-by ones have not been properly treated, and even under such circumstances the success of the method in one field will be a powerful stimulus toward its general adoption the following season.

It is true that the recommendations contained in this circular involve considerable change in the culture of cotton. Nevertheless the important changes that have been brought about, up to this time, in the use of improved seed and fertilizers have also been revolutionary in their character. It is hoped by the Department that the agencies assisting in this matter—namely, organizations of business men—will everywhere devote the same energy toward encouraging the practice of what is, after all, the most important step in maintaining the supremacy of the cotton crop in the weevil territory.

Approved:
JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *September 3, 1908.*

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